



2018

Knoxville Residential Code

Significant Changes (proposed)

December 20, 2018

By James Tente, MCP, CBO, CFM

jtente@knoxvilletn.gov



Goals

- The goal of these presentations is to identify and discuss the building code changes and the impacts on our stakeholders.
- The position of the building department has been to adopt the codes **with the fewest** amendments.



Appendices--Adopted

- ~~A Sizing of Gas Piping~~
- ~~B Sizing of Venting Systems~~
- ~~C Exit Terminals of Direct Vent/Mech Draft~~
- ~~D Recommended Safety Inspection/Existing Appliances~~
- E. Manufactured Housing Used as Dwellings
- F. Radon Control Methods
- ~~G Piping Standards~~
- H-Patio Covers
- ~~I Private Sewage Disposal~~
- ~~J Existing Buildings and Structures~~
- K-Sound Transmission
- ~~L Permit Fees~~
- ~~M Home Daycare in R-3~~
- ~~N Venting Methods~~
- ~~O Auto Vehicle Gates~~
- ~~P Sizing of Water Piping~~
- Q-Tiny Houses
- R-Light Straw-Clay Construction
- S-Straw bale Construction
- ~~T Solar Ready Homes~~



Permit Expiration



- Permits are valid for 365 days from the date of issuance.
- Permits can be renewed.



Foundation Inspections—Required.



R202-Accessory Structures

- A structure ~~not greater than 3,000 sq.ft. in floor area, and not more than two stories in height, the use of which that is customarily accessory to and incidental to that of the dwelling(s) and which that is located on the same lot.~~
- (2015) Height increased to 3 stories maximum.
- IRC height and areas are SEPARATE from ZONING Regulations.



R202-Change of Occupancy

SECTION R110 CERTIFICATE OF OCCUPANCY

R110.1 Use and occupancy.

A building or structure shall not be used or occupied, and a *change of occupancy* or change of use of a building or structure or portion thereof shall not be made, until the *building official* has issued a certificate of occupancy therefor as provided herein. Issuance of a certificate of occupancy shall not be construed as an approval of a violation of the provisions of this code or of other ordinances of the *jurisdiction*. Certificates presuming to give authority to violate or cancel the provisions of this code or other ordinances of the *jurisdiction* shall not be valid.

Exceptions:

1. Certificates of occupancy are not required for work exempt from permits under Section R105.2.
2. Accessory buildings or structures.

R110.2 Change in use.

Changes in the character or use of an existing structure shall not be made except as specified in Sections 407 and 408 of the *International Existing Building Code*.

- A change in the use of a building or portion of a building that involves a change in the application of the requirements of this code.
- A definition for “Change of Occupancy” has been added and the requirement for a certificate of occupancy when there is a change of occupancy or use has been clarified.

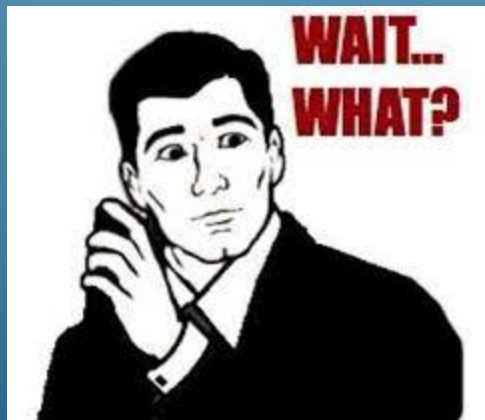
Certificate of Occupancy
Chaffee County
Building Safety Department

This Certificate issued pursuant to the requirements of the 2006 International Building Code or the 2009 International Residential Code certifying that at the time of issuance this structure was in compliance with the various ordinances of the County/Municipality regulating building construction or use. For the following:

Building Site Address _____ Building Permit No. 10045003
Owner Susan Tweit Address PO Box 578, Salida CO 81201
Use Classification/Occupancy SFD Type of Construction V-B
Portion of Structure 725 Sq. Ft. Living Area with 259 Sq. Ft. Deck
Special Stipulations & Conditions _____ Occupant Load _____
Sprinkler Installed: Yes ☐ No ☒ If yes, required: Yes ☐ No ☒ Code Section _____
Jurisdiction City of Salida
[Signature] Building Official May 2, 2014
Date

R202-Crawl Spaces

- An underfloor space that is not a basement.
- No previous definition existed.



R301.2.1.1.1-Sunrooms(2015)

- Sunrooms shall comply with AAMA/NPEA/NSA 2100.
- Five different categories:



R301.2.1.1.1-Sunrooms(2015)—Cat I

- Category I
 - A thermally isolated sunroom with walls that are open or enclosed with insect screening or 0.5mm plastic film. The space is non-habitable and unconditioned.
 - Defined for purpose of energy (N1102.2) requirements.



R301.2.1.1.1-Sunrooms(2015)—Cat II

- Thermally isolated sunroom with enclosed walls.
- The openings are enclosed with translucent or transparent plastic or glass.
- The space is non-habitable and unconditioned.



R301.2.1.1.1-Sunrooms—Cat III

- Thermally isolated sunroom with enclosed walls.
- The openings are enclosed with translucent or transparent plastic or glass.
- The sunroom fenestration complies with additional requirements for air infiltration resistance and water infiltration resistance.
- The space is non-habitable and unconditioned.



R301.2.1.1.1-Sunrooms(2015)--Cat IV

- Category IV
 - Thermally isolated sunroom with enclosed walls. The sunroom is designed to be heated or cooled by a separate temperature control or system and is thermally isolated from the primary structure.
 - The sunroom fenestration complies with the additional requirements for water penetration resistance, air infiltration resistance and thermal performance.
 - The space is non-habitable and conditioned.



R301.2.1.1.1-Sunrooms(2015)--Cat V

- A sunroom with enclosed walls.
- The sunroom is designed to be heated or cooled and is open to the main structure.
- The sunroom fenestration complies with the additional requirements for water penetration resistance, air infiltration resistance and thermal performance.
- The space is habitable and conditioned.



Table R301.2(1) Climate and Geographic

TABLE R301.2(1)
CLIMATIC AND GEOGRAPHIC DESIGN CRITERIA

GROUND SNOW LOAD ^o	WIND DESIGN				SEISMIC DESIGN CATEGORY ^f	SUBJECT TO DAMAGE FROM			WINTER DESIGN TEMP ^e	ICE BARRIER UNDERLAYMENT REQUIRED ^h	FLOOD HAZARDS ^g	AIR FREEZING INDEX ⁱ	MEAN ANNUAL TEMP ^j
	Speed ^d (mph)	Topographic effects ^k	Special wind region ^l	Wind-borne debris zone ^m		Weathering ^a	Frost line depth ^b	Termite ^c					
10	90	N	N	N	C	Severe	12	M/H	19 F	N	—	210	59.4

ASCE/SEI

American Society of Civil Engineers
Structural Engineering Institute
1801 Alexander Bell Drive
Reston, VA 20191-4400

7—16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

7-10

R301.2.1.1, R301.2.1.2, R301.2.1.2.1, R301.2.1.5, R301.2.1.5.1, Table R608.6(1), Table R608.6(2), Table R608.6(3), Table R608.6(4), Table R608.7(1A), Table R608.7(1B), Table R608.7(1C), R608.9.2, R608.9.3, R609.2, R609.6.2

24—14: Flood-resistant Design and Construction

R301.2.4, R301.2.4.1, R322.1, R322.1.1, R322.1.6, R322.1.9, R322.2.2, R322.3.3

32—17: Design and Construction of Frost-protected Shallow Foundations

R403.1.4.1

R302-Fire Resistant Construction

- All references moved to R302 for simplicity:
 - Exterior Walls
 - Townhouse Separation
 - Two-family Separation
 - Penetrations
 - Garage to Dwelling
 - Under Stairs
 - Foam Plastics
 - Interior Finishes
 - Fireblocking
 - Draftstopping
 - Insulation



R302.2.4-Townhouses-Structrual Independence

- Each townhouse shall be structurally independent.
- Exceptions:
 - Foundations
 - Roof and Wall Sheathing
 - Non-structural Wall Coverings
 - Flashing
 - Townhouses separated by a common wall



R302.1(1) Fire Resistance Table Changed

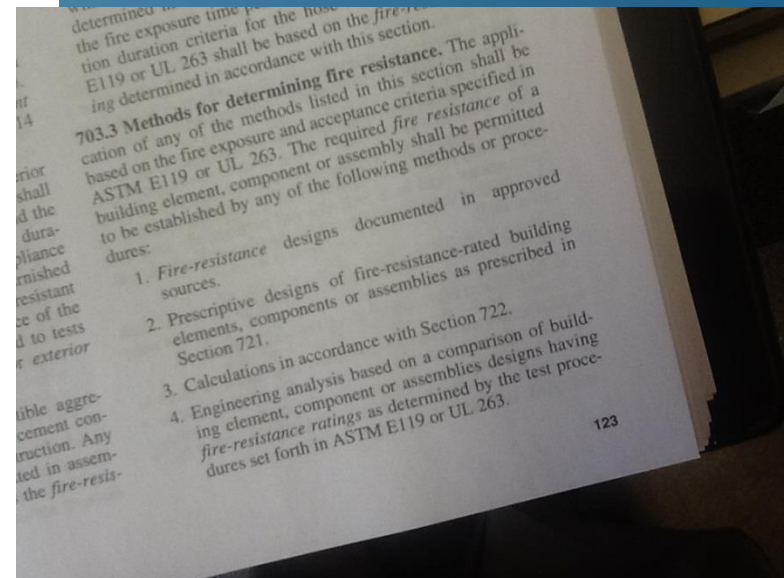
- Footnote added to the table: 1 Hour-tested in accordance with ASTM E119, UL 263 or Section 703.3 of the International Building Code with exposure from both sides.

UL 263

Fire Tests of Building Construction and Materials

- Fire-rating certifications based upon test method and acceptance criteria.
- Ratings are expressed in minutes or hours
 - 20/45/60/90/120/180 minutes
- Applicable to
 - Floor-ceilings
 - Roof-ceilings
 - Beams
 - Columns
 - Walls and partitions

Prefix Letters	Group of Construction
A	Floor-Ceiling Designs • Concrete with Cellular Steel Floor Units and Beam Support
D	Floor-Ceiling Designs • Concrete with Steel Floor Units and Beam Support
IS	Floor-Ceiling Designs • Concrete and Steel Joists
I	Non-load-bearing Horizontal Barrier
J or K	Floor-Ceiling Designs • Precast and Fully Finished Concrete
L	Floor-Ceiling Designs • Wood or Combination Wood and Steel Joist Assemblies
N	Beam Designs for Floor-Ceiling Assemblies
P	Roof-Ceiling Designs
S	Beam Designs for Roof-Ceiling Assemblies
U or V	Wall and Partition Designs
X or Y	Column Designs



R302.1(1) Fire Resistance Table Changed(2015)

- Foot note b, 0 hours required for eave where no gable vent not allowed, 0 hours required.
- Fire resistance requirements where less than <2 FSD now included for clarity.

**TABLE R302.1(1)
EXTERIOR WALLS**

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E 119 or UL 263 with exposure from both sides	< 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	N/A	< 2 feet
	Fire-resistance rated	1 hour on the underside ^{a, b}	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Openings in walls	Not allowed	N/A	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet

For SI: 1 foot = 304.8 mm.

N/A = Not Applicable.

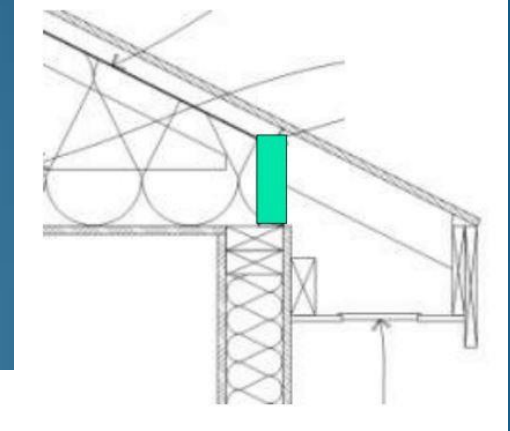
a. Roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave if fireblocking is provided from the wall top plate to the underside of the roof sheathing.

b. Roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave provided that gable vent openings are not installed.



R302.1(1) Fire Resistance Table Changed(2015)

- Foot note a, fire blocking reduces projection to 0 hours required.



**TABLE R302.1(1)
EXTERIOR WALLS**

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E 119 or UL 263 with exposure from both sides	< 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	N/A	< 2 feet
	Fire-resistance rated	1 hour on the underside ^{a, b}	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Openings in walls	Not allowed	N/A	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet

For SI: 1 foot = 304.8 mm.

N/A = Not Applicable.

- Roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave if fireblocking is provided from the wall top plate to the underside of the roof sheathing.
- Roof eave fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave provided that gable vent openings are not installed.

R302.1(1) Fire Resistance Table Changed

- 2018

TABLE R302.1(1)
EXTERIOR WALLS

EXTERIOR WALL ELEMENT		MINIMUM FIRE-RESISTANCE RATING	MINIMUM FIRE SEPARATION DISTANCE
Walls	Fire-resistance rated	1 hour—tested in accordance with ASTM E119, UL 263 or <u>Section 703.3 of the International Building Code</u> with exposure from both sides	0 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Projections	Not allowed	NA	< 2 feet
	Fire-resistance rated	1 hour on the underside, <u>or heavy timber, or fire-retardant-treated wood^{a, b}</u>	≥ 2 feet to < 5 feet
	Not fire-resistance rated	0 hours	≥ 5 feet
Openings in walls	Not allowed	NA	< 3 feet
	25% maximum of wall area	0 hours	3 feet
	Unlimited	0 hours	5 feet
Penetrations	All	Comply with Section R302.4	< 3 feet
		None required	3 feet

For SI: 1 foot = 304.8 mm.

NA = Not Applicable.

- The fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the eave overhang if fireblocking is provided from the wall top plate to the underside of the roof sheathing.
- The fire-resistance rating shall be permitted to be reduced to 0 hours on the underside of the rake overhang where gable vent openings are not installed.

R302.2.4.2 Membrane Penetrations

- New Exception #4:
 - Ceiling membrane penetrations by listed luminaires or by luminaires protected with listed materials that have been tested for use in fire resistance rated assemblies and are installed in accordance with the instructions included with the listing.



R302.13-Fire Protection of Floors

- Exception 2:
 - Floor assemblies located directly over a crawl space not intended for storage or fuel fired equipment or electric powered heating appliances.



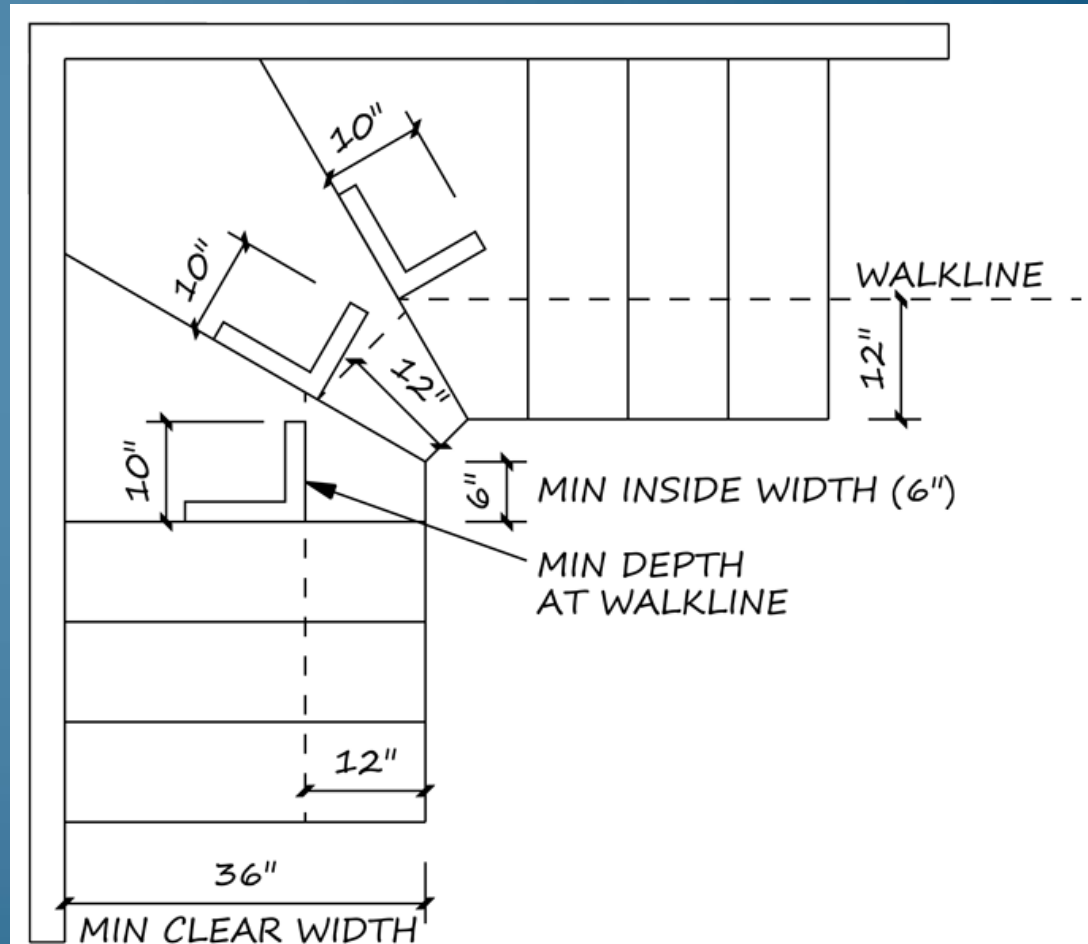
R302.5 Opening Protection

- Self closing or automatic closing doors opening from a garage to the residence required.
 - Previously amended out of the code.

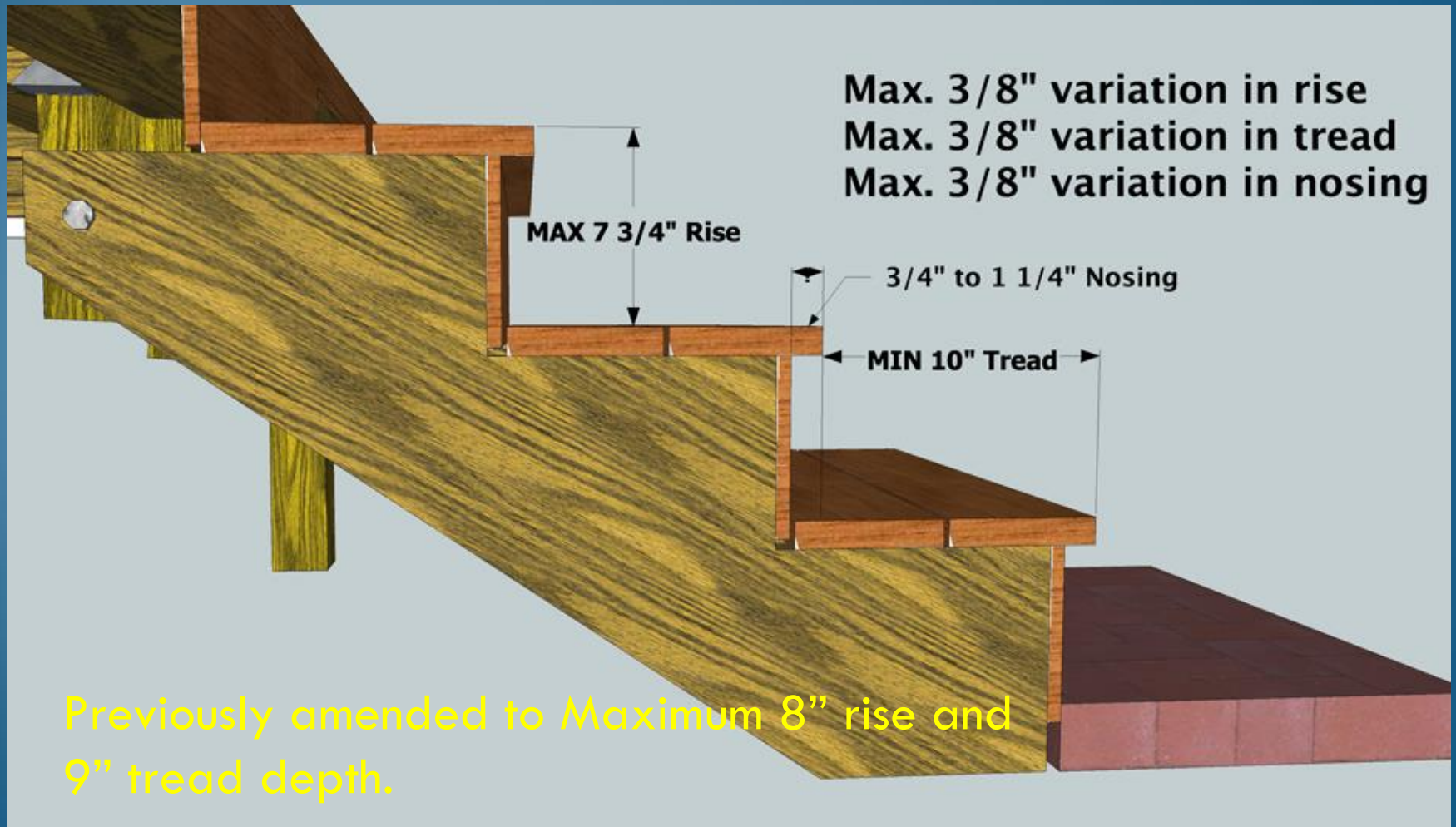


R311.7.4-Winder Stairs: Walkline

- The walkline across winder treads and landings shall be concentric to the turn and parallel to the direction of travel entering and exiting a turn.
- The walkline shall be located 12 inches from the inside of the turn.
- The 12 inch dimension shall be measured from the widest clear stair width at the walking surface.
- Minimum tread depth of ~~9"~~ 10" measured between the vertical planes of the foremost projections at intersection of walkline.
- Winder treads shall have a ~~4"~~ 6" min at any point.

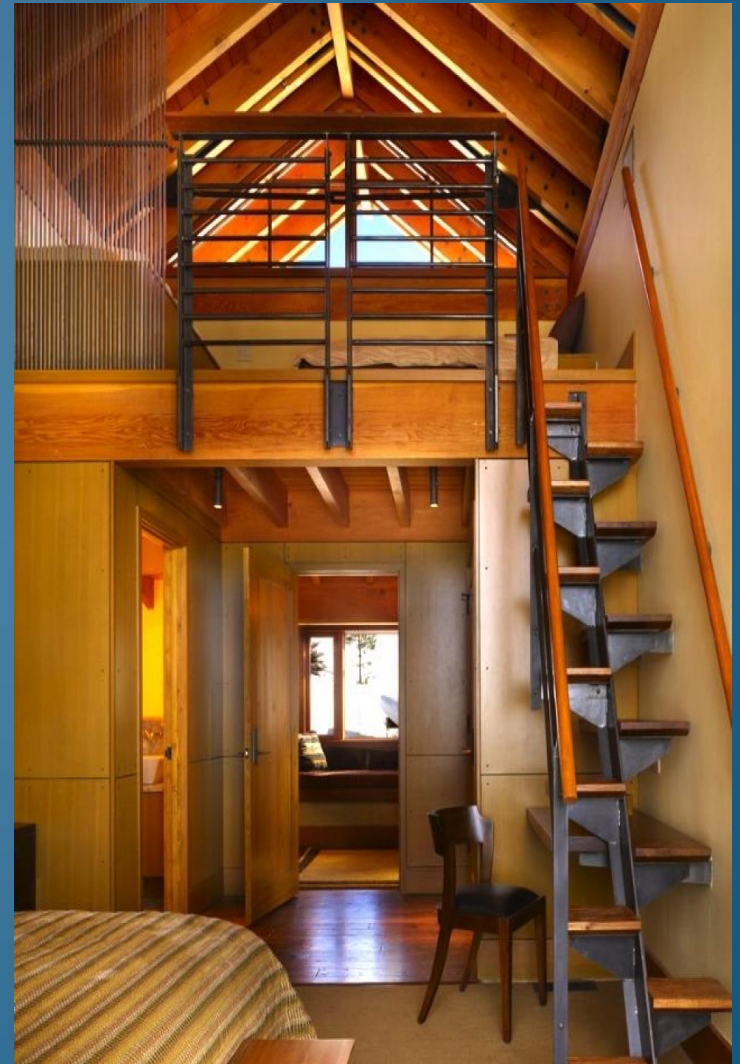


R311.7.5 Stair Treads and Risers



R311.7.11 Alternating Tread Devices

- New exception:
 - Alternating tread devices are allowed to be used as an element of a means of egress for lofts, mezzanines and similar areas of 200 gross square feet or less where such devices DO NOT provide exclusive access to a kitchen or bathroom.

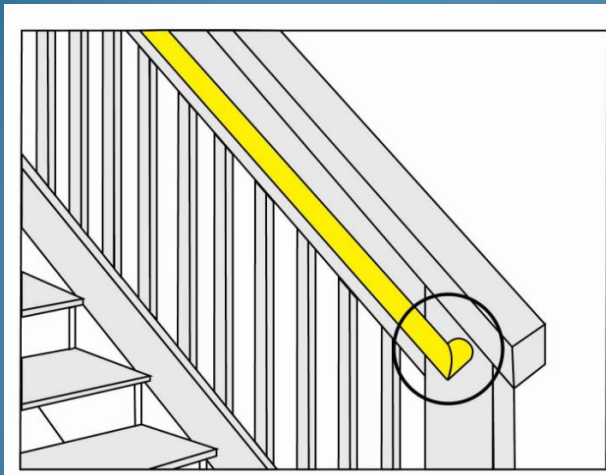


R311.7.12 Ships Ladders

- New Exception:
 - Ship ladders are allowed to be used as an element of a means of egress for lofts, mezzanines and similar areas of 200 gross square feet or less that do not provide exclusive access to kitchen or bathrooms.



R311.7.8 Handrails Required



~~30" amendment
deleted.~~

- All stairs with 4 or more risers shall have a graspable handrail.



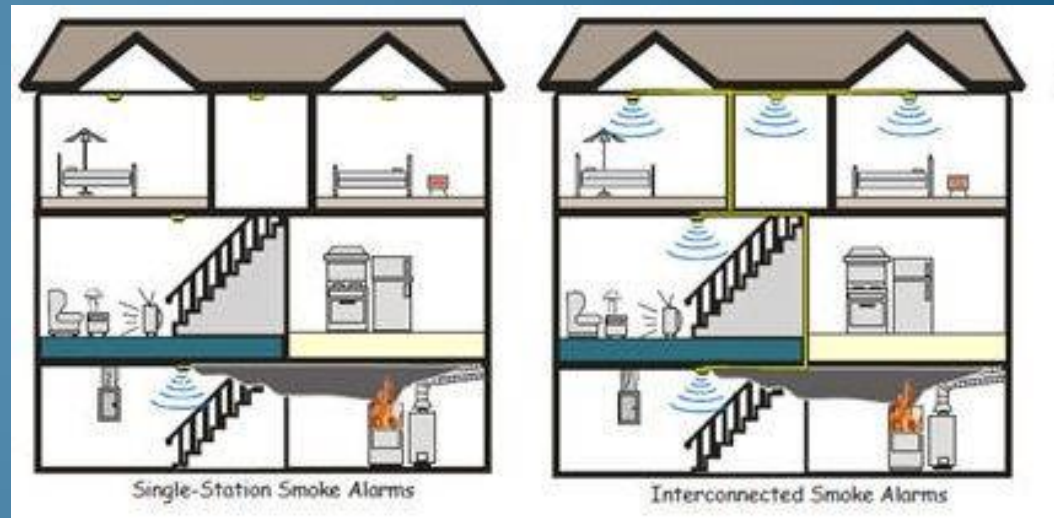
R313 Automatic Sprinkler Systems

- Not required.
- Tennessee Code Annotated § 68-120-101(a)(8).



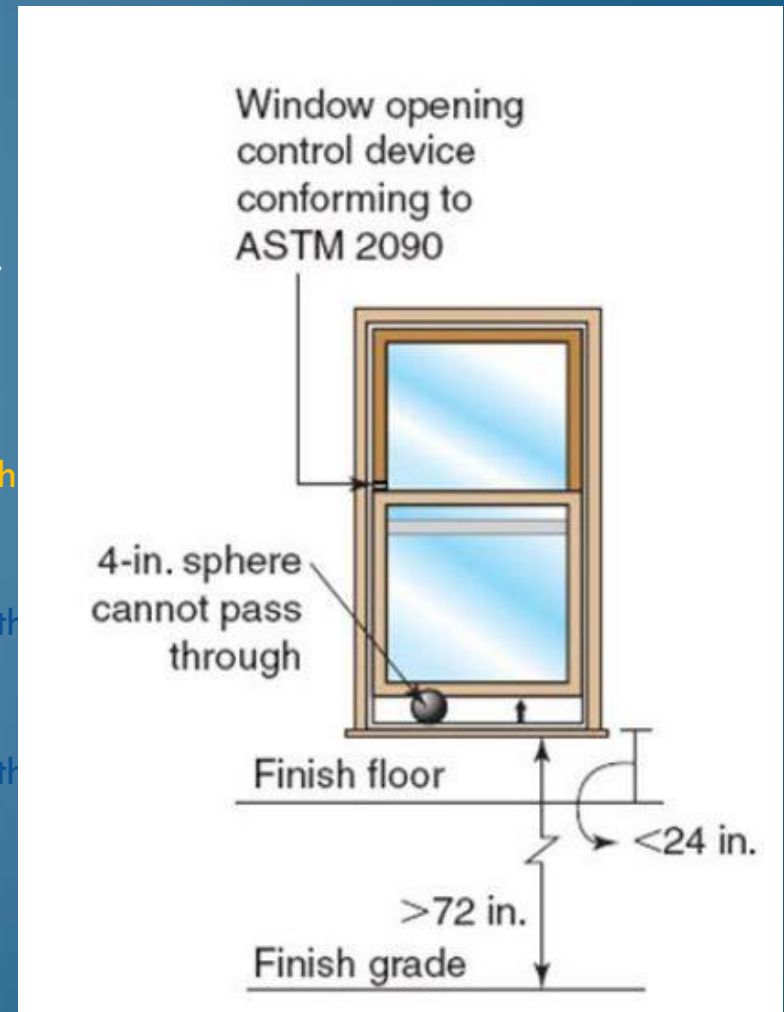
R314.4 Smoke Alarm Interconnection

- Exception Removed:
 - ~~Interconnection of smoke alarms in existing areas shall not be required where alterations or repairs do not result in removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available that could provide access for interconnection without removal of interior finishes.~~
 - The exemption for interconnection of alarms during alterations based on feasibility has been removed from the code.



R312.2 Window Fall Protection

- R312.2.1 Window Sills
 - In dwelling units, where the top of the sill of an operable window opening is located less than 24 inches above the finished floor and greater than 72 inches above the finished grade or other surface below on the exterior of the building the operable window shall comply with ONE of the following:
 - Operable window openings will not allow a 4 inch sphere to pass through where the openings are at their largest opened position.
 - Operable windows are provided with window fall protection devices that comply with ASTM F2090.
 - Operable windows are provided with window opening control devices that comply with R312.2.2.



R312.2 Window Fall Protection

- R312.2.1 Window Sills
 - In dwelling units, where the top of the sill of an operable window opening is located less than 24 inches above the finished floor and greater than 72 inches above the finished grade or other surface below on the exterior of the building the operable window shall comply with ONE of the following:
 - Operable window openings will not allow a 4 inch sphere to pass through where the openings are at their largest opened position.
 - Operable windows are provided with window fall protection devices that comply with ASTM F2090.
 - Operable windows are provided with window opening control devices that comply with R312.2.2.



R315.5 CO Alarm Interconnection

- When more than one required they shall be interconnected.
- Interconnection can be through listed wireless devices.
- Exception:
 - Interconnection of smoke alarms in existing areas shall not be required where alterations or repairs do not result in removal of interior wall or ceiling finishes exposing the structure, unless there is an attic, crawl space or basement available that could provide access for interconnection without removal of interior finishes.



R324 Roof Top Solar-Requirements

- R324.2 Solar Thermal Systems
- R324.3 Photovoltaic Systems
- R324.4 Roof Top Systems
- R324.5 Building Integrated
- R324.6 Roof Access
- R324.7 Ground Mounted Systems
- Requirements for roof access and pathways for firefighters have been introduced into the IRC provisions for rooftop mounted photovoltaic solar energy systems.
- Rooftop mounted photovoltaic solar energy panels and modules are not permitted to be installed below emergency escape and rescue openings.



R325.6 Habitable Attics

- Shall not be considered a Story where:
 1. Occupiable floor area is not less than 70sq.ft.
 2. Occupiable floor area has R305 ceiling heights.
 3. Occupiable area is enclosed by roof assembly above, knee walls on the sides and floor/ceiling assembly below.



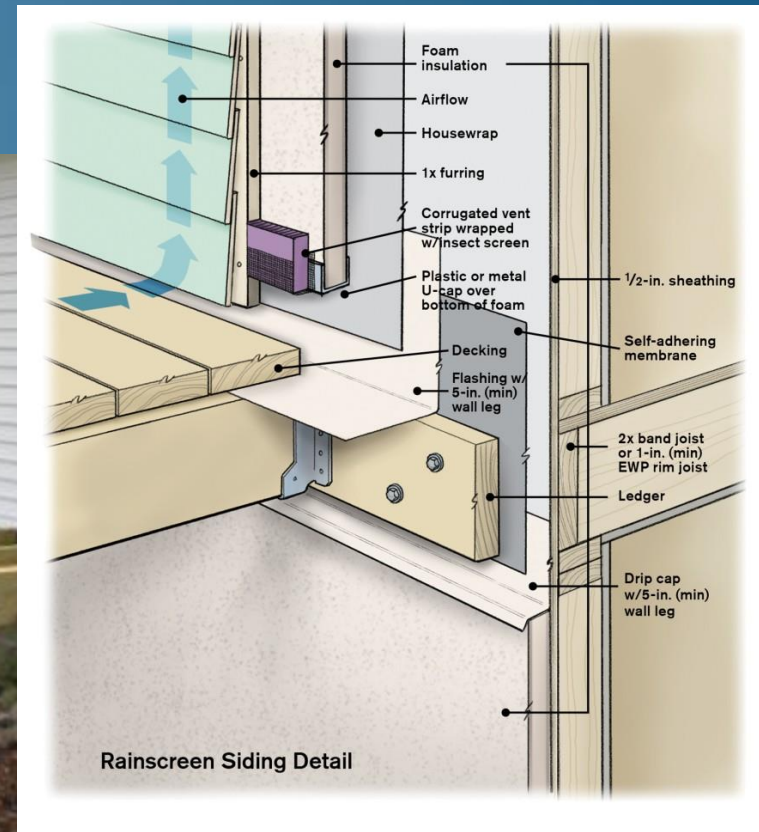
R408.3 Unvented Crawlspace

- Provisions for elimination of ventilation openings where:
- Dehumidification:
 - System sized to provide 70 pints of moisture removal per day for every 1,000sq.ft. of crawl space floor area.
 - Ventilation of the under-floor space is not required when an adequately sized dehumidifier is provided.



R507 Decks

Significant re-organization and addition to provide more direction for deck design and construction.



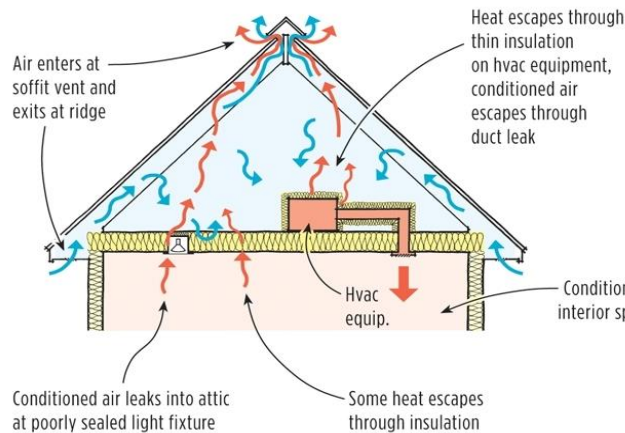
R806.5 Unvented Attics

- Unvented attics and unvented enclosed roof framing assemblies created by ceilings that are applied directly to the underside of the roof framing members and structural roof sheathing applied directly to the top of the roof framing members/rafters, shall be permitted where all the following conditions are met:
 - 1. The unvented attic space is completely within the building thermal envelope.
 - 2. No interior Class I vapor retarders are installed on the ceiling side (attic floor) of the unvented attic assembly or on the ceiling side of the unvented enclosed roof framing assembly.
 - 3. Where wood shingles or shakes are used, a minimum 1/4-inch (6.4 mm) vented airspace separates the shingles or shakes and the roofing underlayment above the structural sheathing.
 - 5. Insulation shall be located in accordance with the following: 5.1. Item 5.1.1, 5.1.2, 5.1.3 or 5.1.4 shall be met...

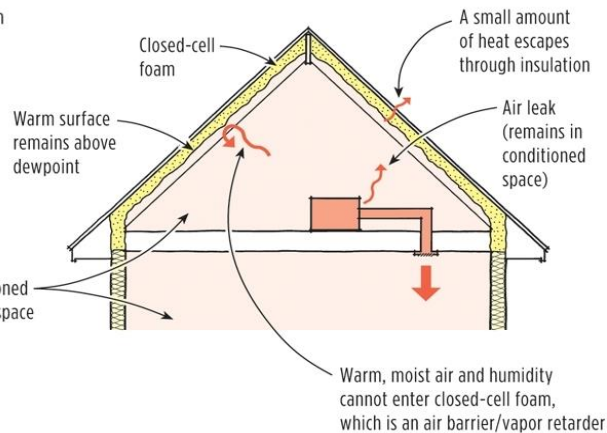
Vented vrs Unvented Attics--Concept

Vented vs. Unvented Attics

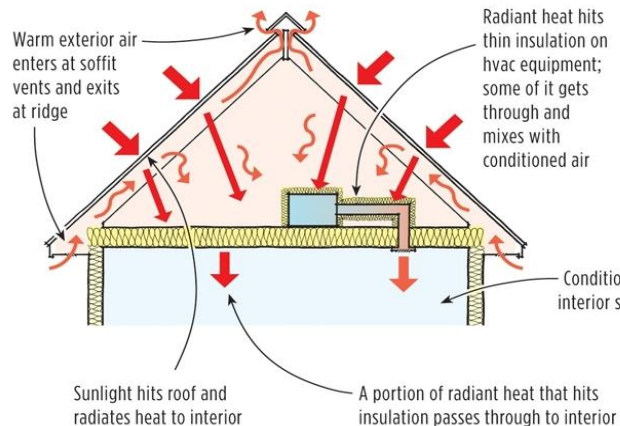
Vented Attic in Winter



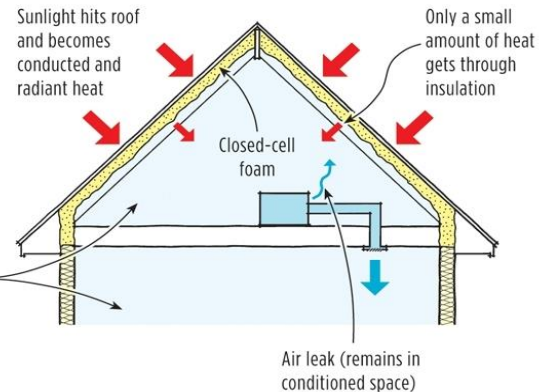
Unvented Attic in Winter



Vented Attic in Summer



Unvented Attic in Summer



N1102.1.2 Insulation and Fenestration

TABLE N1102.1.2 (R402.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,g}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^e WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13 + 5 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13 + 5 ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. U-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed R-value of the insulation shall not be less than the R-value specified in the table.

b. The fenestration U-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure N1101.10 and Table N1101.10.

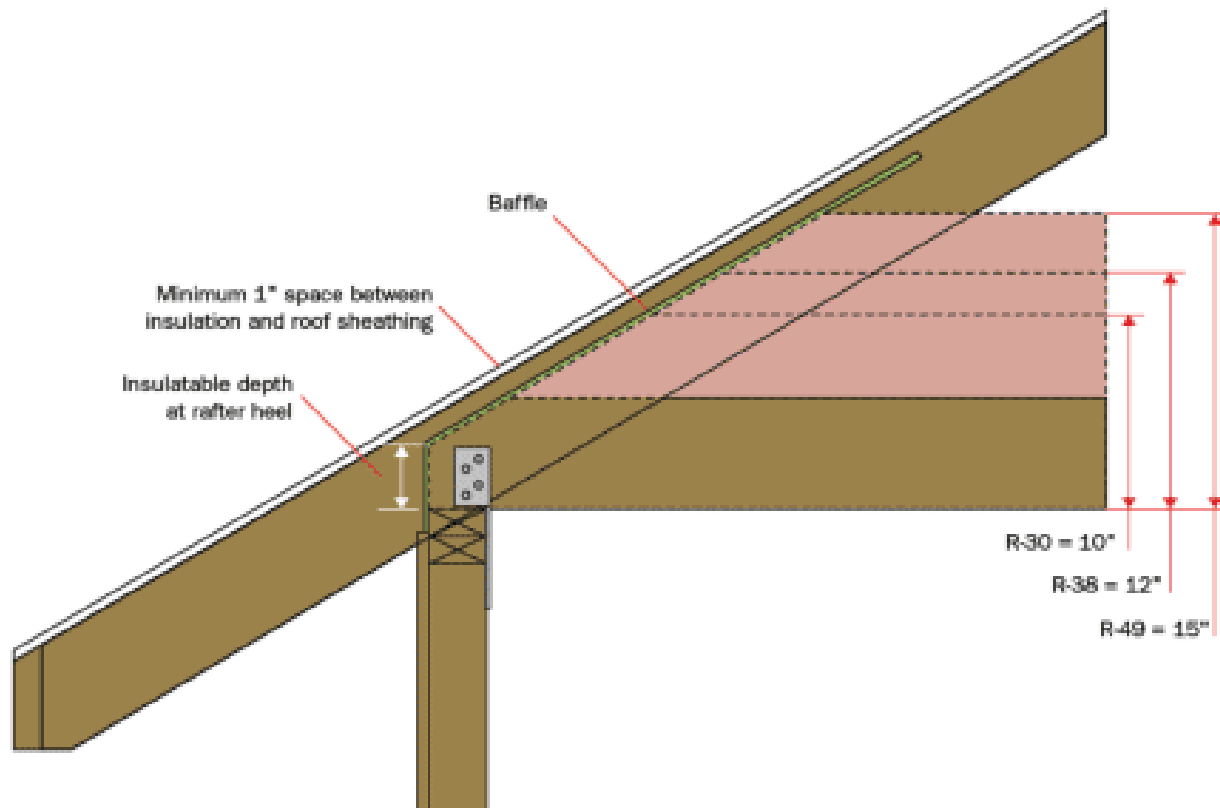
g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. The first value is cavity insulation, the second value is continuous insulation, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

i. The second R-value applies when more than half the insulation is on the interior of the mass wall.

Non-Energy Trusses...R-49 Required

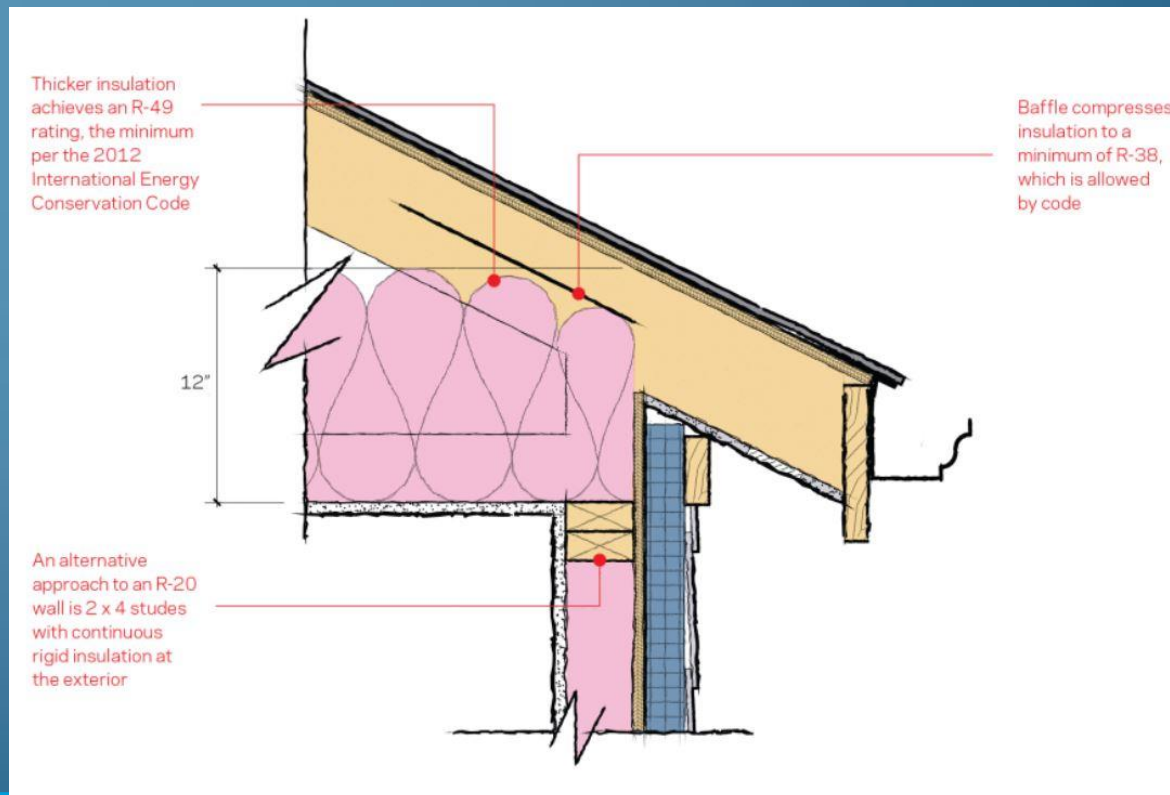
Typical Attic Insulation with “Regular Heel”



Non-Energy Trusses...R-38 Required

N1102.2.1 (R402.2.1) Ceilings with attic spaces.

Where Section R1102.1.2 requires R-38 insulation in the ceiling, installing R-30 insulation over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-38 insulation wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Where Section N1102.1.2 requires R-49 insulation in the ceiling, installing R-38 insulation over 100 percent of the ceiling area requiring insulation shall satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction shall not apply to the *U*-factor alternative approach in Section N1102.1.4 and the Total UA alternative in Section N1102.1.5.



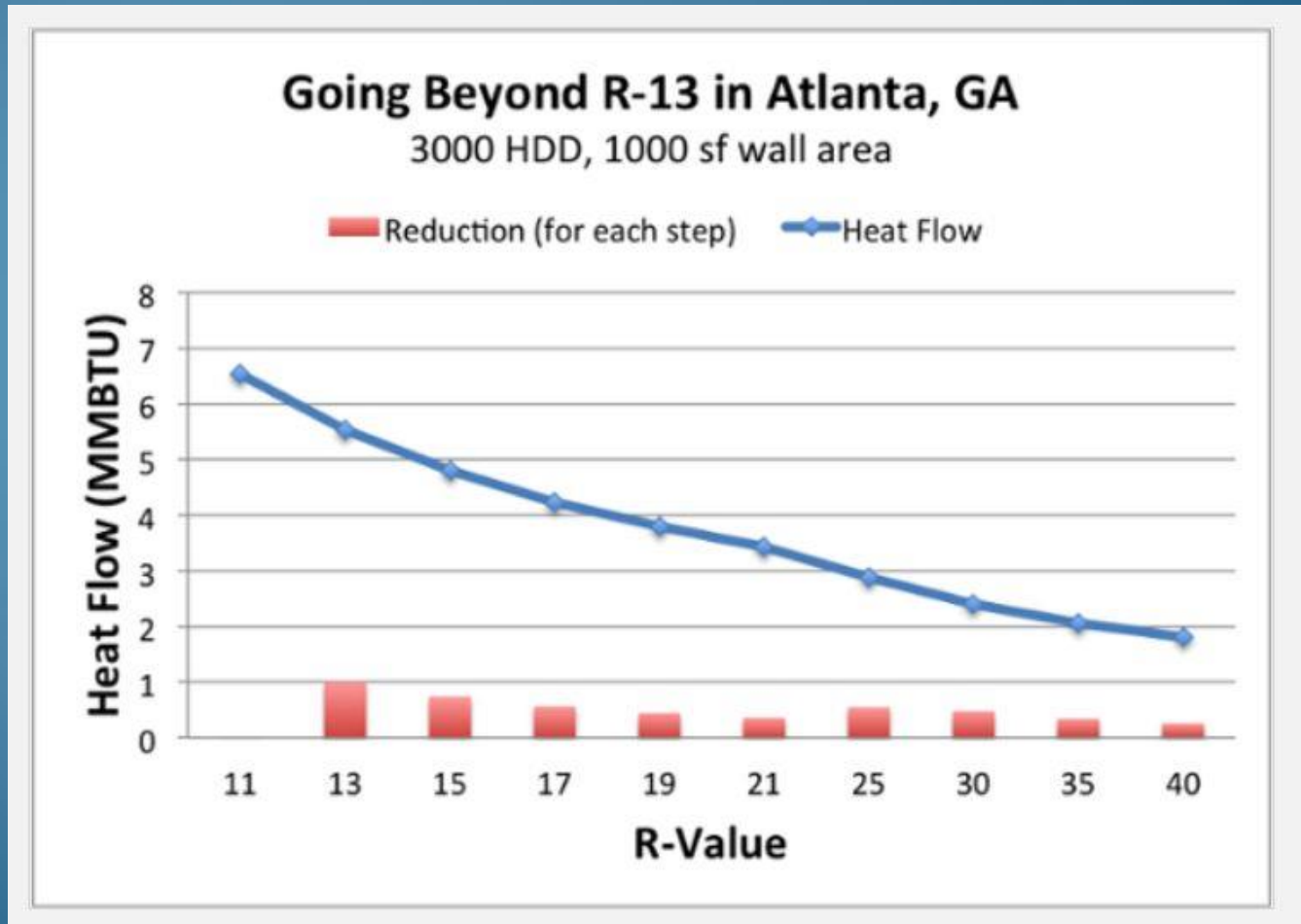
Compliance Options

4 different compliance options...

METHODOLOGIES AND NOTES

The IECC provides four different compliance options for residential buildings. The most easy-to-use option is the prescriptive insulation and fenestration compliance path provided in Section R402. The assemblies in this publication are deemed to be equivalent to the frame wall assemblies of the prescriptive insulation requirements specified in Table R402.1.1 of the 2009 and 2012, and Table R402.1.2 of the 2015 IECC for those climate zones that require R20 or R13+5 insulation. A two-dimensional assembly U-factor calculation using the parallel path method as outlined in *ASHRAE Handbook – Fundamentals* (Chapter 27) was used to determine the assemblies that are equivalent to the R20 benchmark wall assemblies based on the insulation requirements of IECC. This methodology utilizes the U-factors shown in Table 4 of ESR-2586,¹ issued in accordance with the acceptable criteria for determining wood-frame wall assemblies as noted in ICC-ES Environmental Criteria EC115² and Section R102 of the IECC,³ to show equivalency to the 2009 and 2012 IECC. To show equivalency to the 2015 IECC, this methodology utilizes Table R402.1.4 in the 2015 code. (Note for energy raters: During the 2015 IECC code development process, all frame wall U-factors in Table R402.1.3 of the 2012 IECC were revised. The equivalent U-factor for R20 or R13+5 wall assemblies is 0.060 in the 2015 code.)

How Much is Too Much?



R20 WALL ASSEMBLY A

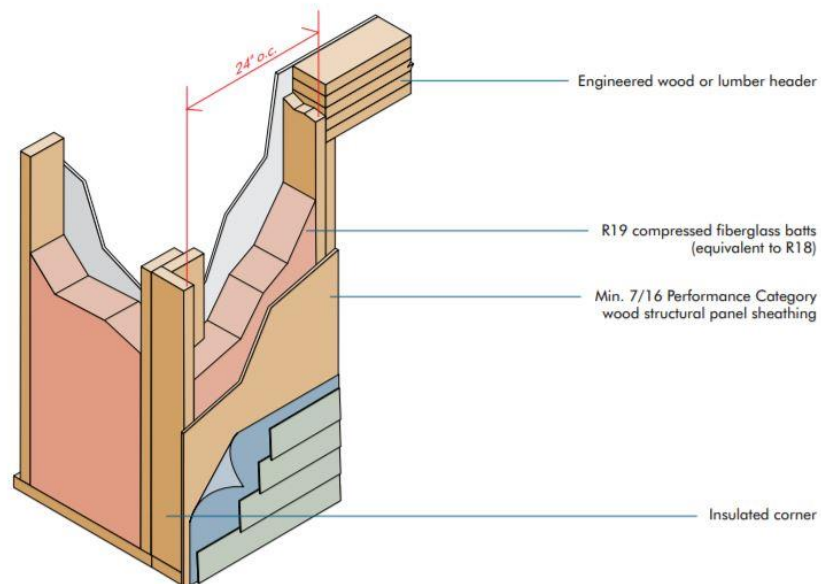
LOW-DENSITY FIBERGLASS INSULATION / ADVANCED FRAMING TECHNIQUES

In order to offset the performance of lower-cost R19 compressed fiberglass batts (equivalent to R18) as cavity insulation, this 2x6 wall assembly incorporates advanced framing techniques. The assembly includes conventional headers and double top plates. The framing factor is assumed to be no greater than 20 percent.^a

2x6 with R19 Batt Insulation, Advanced Framing

COMPONENTS	R-VALUES
Wood/Vinyl Siding	0.59
Min. 7/16 Performance Category Wood Structural Panels	0.62
Cavity Insulation (R19 compressed fiberglass batts)	18
5-1/2" Framing	6.88
5-1/2" Headers – Conventional	6.88
16% framing + 4% headers = 20% framing factor	
Air films and 1/2" Drywall	1.38
Net Effective R-Value of the Total Solid Wall	16.67
Total Wall U-Factor	0.060

a. 20% framing factor is calculated using studs at 24" o.c. (framing factor = 22%) with a combination of insulated corners, insulated interior-exterior wall intersections and limited cripple supports at door and window openings (4% maximum reduction in framing percentage, 2% assumed). See page 7 for additional information. This assembly is subject to verification and approval by the local authority having jurisdiction.



R20 WALL ASSEMBLY B

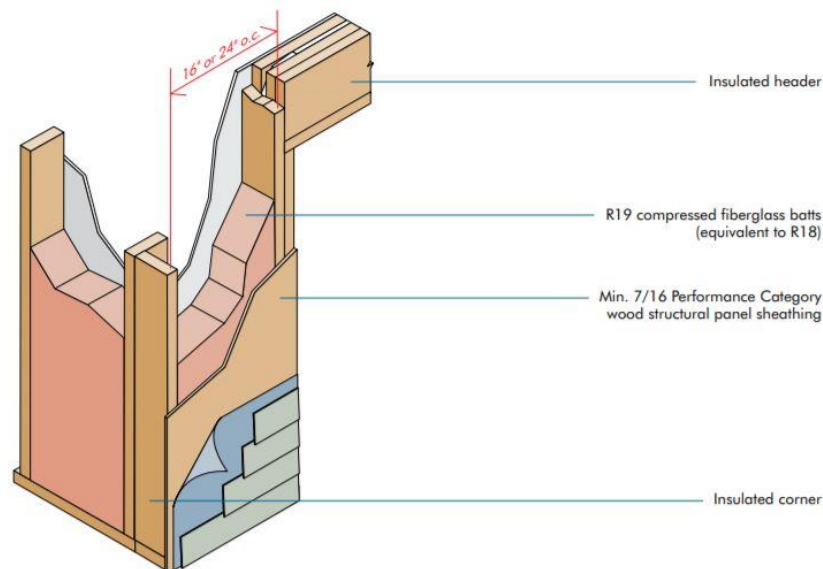
LOW-DENSITY FIBERGLASS INSULATION / INSULATED HEADERS

This assembly uses insulated headers and advanced framing techniques to increase thermal values. It uses R19 compressed fiberglass batts (equivalent to R18) as cavity insulation. The assembly includes double top plates. The framing factor is assumed to be no greater than 22 percent.^a

2x6 with R19 Batt Insulation, Insulated Headers, Advanced Framing

COMPONENTS	R-VALUES
Wood/Vinyl Siding	0.59
Min. 7/16 Performance Category Wood Structural Panels	0.62
Cavity Insulation (R19 compressed fiberglass batts)	18
5-1/2" Framing	6.88
5-1/2" Insulated Headers	9.6 ^b
Air films and 1/2" Drywall	1.38
Net Effective R-Value of the Total Solid Wall	16.62
Total Wall U-Factor	0.060

- a. 22% framing factor is calculated using studs at 24" o.c. (framing factor = 22%), or studs at 16" o.c. (framing factor = 25%) with a combination of insulated corners, insulated interior-exterior wall intersections and limited cripple supports at door and window openings (4% maximum reduction in framing percentage, 3% assumed). See page 7 for additional information. This assembly is subject to verification and approval by the local authority having jurisdiction.
- b. R9.6 represents a triple-ply wood header consisting of 4.5" of wood and 1" of minimum R4/inch insulation. Any header that exceeds this R-value (e.g., an R13.8 double-ply header, as shown in Table 2) can be used.



R20 WALL ASSEMBLY C

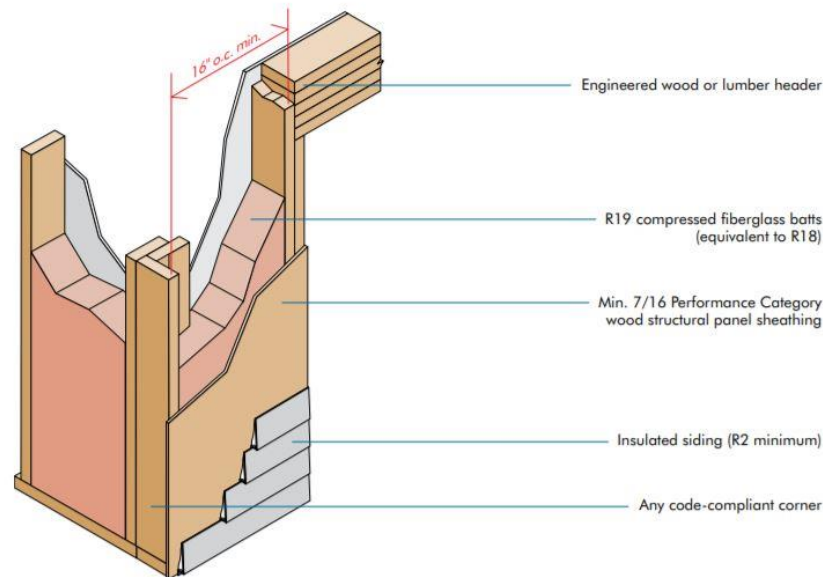
LOW-DENSITY FIBERGLASS INSULATION / INSULATED SIDING

This assembly uses only conventional framing techniques with 2x6 studs and increases thermal values with insulated siding (a minimum insulation value of R2). The assembly includes conventional headers, double top plates and permits the use of R19 compressed fiberglass batts (equivalent to R18) as cavity insulation. The framing factor is assumed to be no greater than 25 percent.^a

2x6 with R19 Batt Insulation, R2 Insulated Siding Conventional Framing

COMPONENTS	R-VALUES
Insulated Siding	2.0
Min. 7/16 Performance Category Wood Structural Panels	0.62
Cavity Insulation (R19 compressed fiberglass batts)	18
5-1/2" Framing – Conventional	6.88
5-1/2" Headers – Conventional	6.88
21% framing + 4% headers = 25% framing factor	
Air films and 1/2" Drywall	1.38
Net Effective R-Value of the Total Solid Wall	17.52
Total Wall U-Factor	0.057

a. 25% framing factor is calculated using studs at 16" o.c. with no advanced framing techniques (no reduction in framing percentage). See page 7 for additional information. This assembly is subject to verification and approval by the local authority having jurisdiction.



BETTER THAN R20 WALL ASSEMBLY D

AGGRESSIVE ADVANCED FRAMING AND INSULATION LEVELS

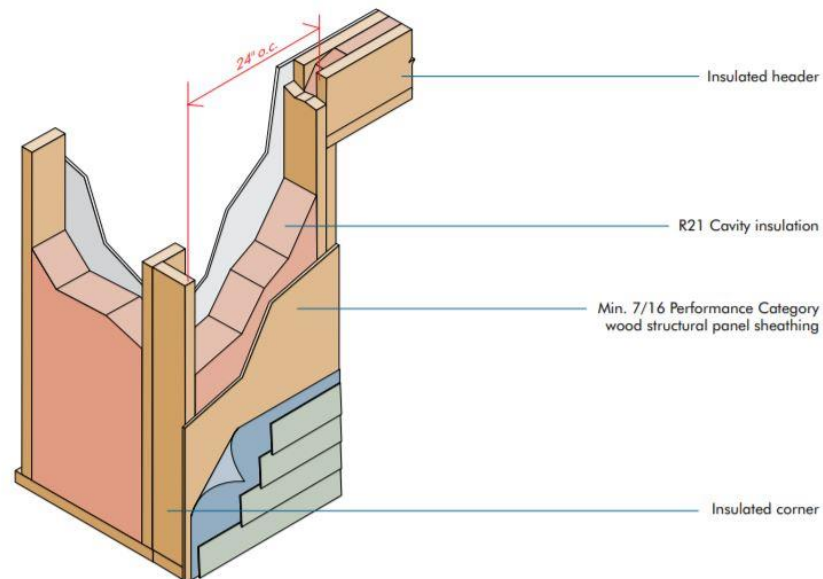
This assembly combines several enhancements to achieve a lower U-factor or higher R-value. It features 2x6 framing and a framing factor of no greater than 18 percent through the use of advanced framing techniques. The assembly includes R21 cavity insulation, insulated headers and double top plates. This assembly exemplifies how the performance of a typical 2x6 wall can be improved with the addition of aggressive advanced framing techniques.^a

2x6 with R21 Batt Insulation, Insulated Headers, Advanced Framing

COMPONENTS	R-VALUES
Wood/Vinyl Siding	0.59
Min. 7/16 Performance Category Wood Structural Panels	0.62
Cavity Insulation (R21 high density fiberglass batts, or equivalent)	21
5-1/2" Framing	6.88
5-1/2" Insulated Headers	13.8 ^b
Air films and 1/2" Drywall	1.38
Net Effective R-Value of the Total Solid Wall	19.24
Total Wall U-Factor	0.052

a. 18% framing factor is calculated using studs at 24" o.c. (framing factor = 22%) with a combination of insulated corners, insulated interior-exterior wall intersections and limited cripple supports at door and window openings (4% reduction in framing percentage). See page 7 for additional information. This assembly is subject to verification and approval by the local authority having jurisdiction.

b. R13.8 represents a double-ply header consisting of 3" of wood and 2-1/2" of minimum R4/inch insulation, as shown in Table 2.



R20 WALL ASSEMBLY E

2x4 WALL

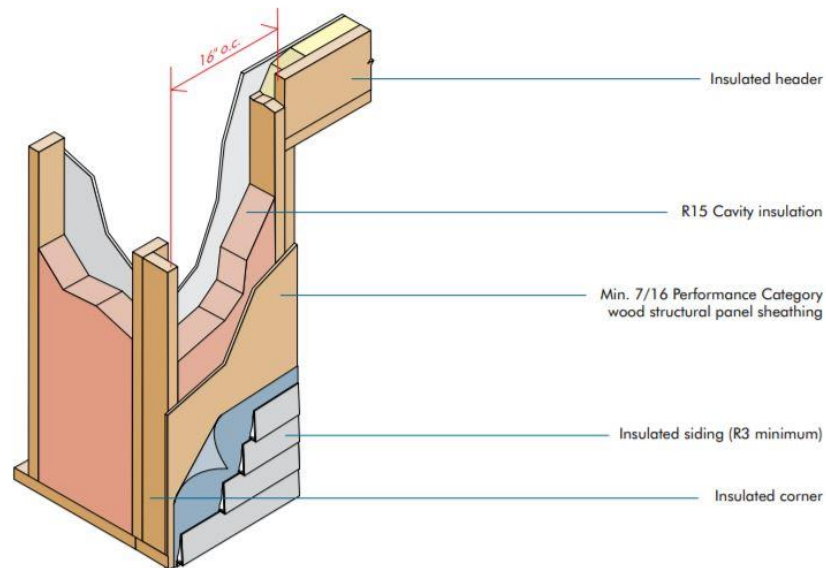
This assembly combines 2x4 framing with some advanced framing techniques. It includes insulated siding, insulated headers, R15 cavity insulation and double top plates. The framing factor is assumed to be no greater than 22 percent.^a

2x4 with R15 Batt Insulation, Insulated Headers, Insulated Siding, Advanced Framing

COMPONENTS	R-VALUES
Insulated Siding	3.0
Min. 7/16 Performance Category Wood Structural Panels	0.62
Cavity Insulation (R15 high density fiberglass batts, or equivalent)	15
3-1/2" Framing	4.38
3-1/2" Insulated Headers	13.9 ^b
Air films and 1/2" Drywall	1.38
Net Effective R-Value of the Total Solid Wall	16.59
Total Wall U-Factor	0.060

a. 22% framing factor is calculated using studs at 16" o.c. (framing factor = 25%) with a combination of insulated corners, insulated interior-exterior wall intersections and limited cripple supports at door and window openings (4% maximum reduction in framing percentage, 3% assumed). See page 7 for additional information. This assembly is subject to verification and approval by the local authority having jurisdiction.

b. R13.9 represents a single-ply wood header consisting of 1.5" of wood and 2" of minimum R6/inch insulation.



IECC COMPLIANCE OPTIONS FOR **WOOD-FRAME WALL ASSEMBLIES**



U-factor Alternative

N1102.1.4 (R402.1.4) U-factor alternative.

An assembly with a *U*-factor equal to or less than that specified in Table N1102.1.4 shall be permitted as an alternative to the *R*-value in Table N1102.1.2.

TABLE N1102.1.4 (R402.1.4)
EQUIVALENT *U*-FACTORS^a

CLIMATE ZONE	FENESTRATION <i>U</i> -FACTOR	SKYLIGHT <i>U</i> -FACTOR	CEILING <i>U</i> -FACTOR	FRAME WALL <i>U</i> -FACTOR	MASS WALL <i>U</i> -FACTOR ^b	FLOOR <i>U</i> -FACTOR	BASEMENT WALL <i>U</i> -FACTOR	CRAWL SPACE WALL <i>U</i> -FACTOR
1	0.50	0.75	0.035	0.084	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.084	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	0.060	0.098	0.047	0.091 ^c	0.136
4 except Marine	0.32	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5 and Marine 4	0.30	0.55	0.026	0.060	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	0.045	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	0.045	0.057	0.028	0.050	0.055

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

b. Mass walls shall be in accordance with Section N1102.2.5. Where more than half the insulation is on the interior, the mass wall *U*-factors shall not exceed 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.

c. In warm-humid locations as defined by Figure N1101.7 and Table N1101.7, the basement wall *U*-factor shall not exceed 0.360.

Total UA Alternative

N1102.1.5 (R402.1.5) Total UA alternative.

Where the total *building thermal envelope* UA, the sum of *U*-factor times assembly area, is less than or equal to the Total UA resulting from multiplying the *U*-factors in Table N1102.1.4 by the same assembly area as in the proposed *building*, the *building* shall be considered to be in compliance with Table N1102.1.2. The UA calculation shall be performed using a method consistent with the ASHRAE *Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to UA compliance, SHGC requirements shall be met.

REScheck

Residential Compliance Using REScheck™

The REScheck product group makes it fast and easy for builders, designers, and contractors to determine whether new homes, additions, and alterations meet the requirements of the IECC or a number of state energy codes. REScheck also simplifies compliance determinations for building officials, plan checkers, and inspectors by allowing them to quickly determine if a low-rise residence meets the code.



REScheck is appropriate for insulation and window trade-off calculations in residential detached one- and two-family buildings and multi-family buildings three stories or less in height above grade, such as apartments, condominiums, and townhouses. REScheck works by performing a simple $U\text{-factor} \times \text{Area (UA)}$ calculation for each building assembly to determine the overall UA of a building. The UA that would result from a building conforming to the code requirements is compared against the UA for your building. If the total heat loss (represented as a UA) through the envelope of your building does not exceed the total heat loss from the same building conforming to the code, the software generates a report that declares your building is compliant with the code.

REScheck Desktop may be downloaded and installed directly to your desktop, while REScheck-Web™ is accessible directly from the website without having to download and install.

Simulated Energy Performance

SECTION N1105 (R405) SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)

N1105.1 (R405.1) Scope.

This section establishes criteria for compliance using simulated energy performance analysis. Such analysis shall include heating, cooling, mechanical ventilation and service water heating energy only.

N1105.2 (R405.2) Mandatory requirements.

Compliance with this section requires that the mandatory provisions identified in Section N1101.13 be met. Supply and return ducts not completely inside the *building thermal envelope* shall be insulated to an *R*-value of not less than R-6.

N1105.3 (R405.3) Performance-based compliance.

Compliance based on simulated energy performance requires that a proposed residence (*proposed design*) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*. Energy prices shall be taken from a source *approved* by the *building official*, such as the Department of Energy, Energy Information Administration's State Energy Data System Prices and Expenditures reports. *Building officials* shall be permitted to require time-of-use pricing in energy cost calculations.

Exception: The energy use based on source energy expressed in Btu (J) or Btu per square foot (J/m^2) of *conditioned floor area* shall be permitted to be substituted for the energy cost. The source energy multiplier for electricity shall be 3.16. The source energy multiplier for fuels other than electricity shall be 1.1.

N1105.4 (R405.4) Documentation.

Documentation of the software used for the performance design and the parameters for the *building* shall be in accordance with Sections N1105.4.1 through N1105.4.3.

N1105.4.1 (R405.4.1) Compliance software tools.

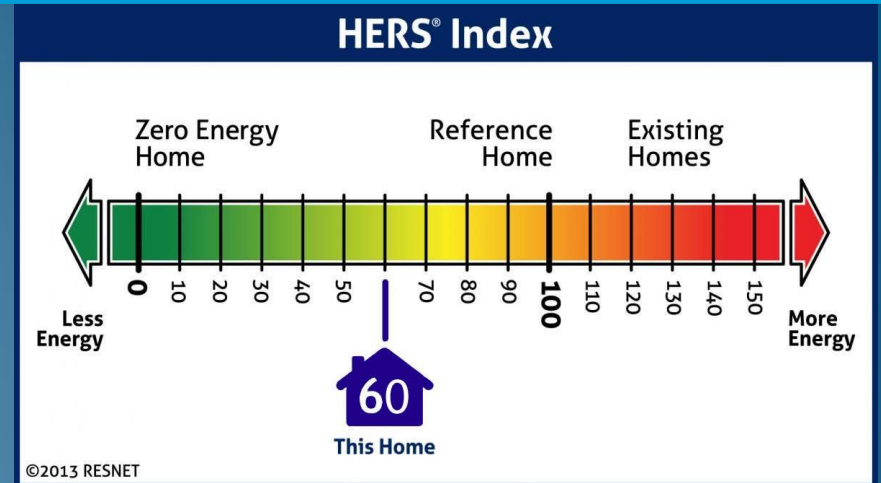
Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this section shall be provided to the *building official*.

N1105.4.2 (R405.4.2) Compliance report.

Compliance software tools shall generate a report that documents that the *proposed design* complies with Section N1105.3. A compliance report on the *proposed design* shall be submitted with the application for the *building* permit. Upon completion of the *building*, a compliance report based on the as-built condition of the *building* shall be submitted to the *building official* before a certificate of occupancy is issued. Batch sampling of *buildings* to determine energy code compliance shall only be allowed for stacked multiple-family units.

Compliance reports shall include information in accordance with Sections N1105.4.2.1 and N1105.4.2.2. Where the *proposed design* of a *building* could be built on different sites where the cardinal orientation of the building on each site is different, compliance of the *proposed design* for the purposes of the application for the building permit shall be based on the worst-case orientation, worst-case configuration, worst-case *building* air leakage and worst-case duct leakage. Such worst-case parameters shall be used as inputs to the compliance software for energy analysis.

Energy Rating Index Alternative



N1106.4 (R406.4) ERI-based compliance.

Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value indicated in Table N1106.4 when compared to the *ERI reference design*.

TABLE N1106.4 (R406.4)
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX ^a
1	57
2	57
3	57
4	62
5	61
6	61
7	58
8	58

a. Where on-site renewable energy is included for compliance using the ERI analysis of Section N1106.4, the building shall meet the mandatory requirements of Section N1106.2, and the building thermal envelope shall be greater than or equal to the levels of efficiency and SHGC in Table N1102.1.2 or Table N1102.1.4.

N1102.1.2 Window U-Factors

- 0.35 to 0.32
- The prescriptive U-factors for fenestration have been lowered to improve the energy efficiency of dwellings and townhouses.

TABLE N1102.1.2 (R402.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,a}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ⁱ	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^e WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5 ^h	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13 + 5 ^h	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13 + 5 ^h	13/17	30 ^g	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	15/20	30 ^g	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 + 5 or 13 + 10 ^h	19/21	38 ^g	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.



N1103.2.2 Ducts Sealing

- Ducts must be sealed.
- Rough in test required (if ducts are not located in the conditioned space)
 - 4 cfm/100sf Floor area w/air handler
 - 3 cfm/100sf Floor area w/0 air handler



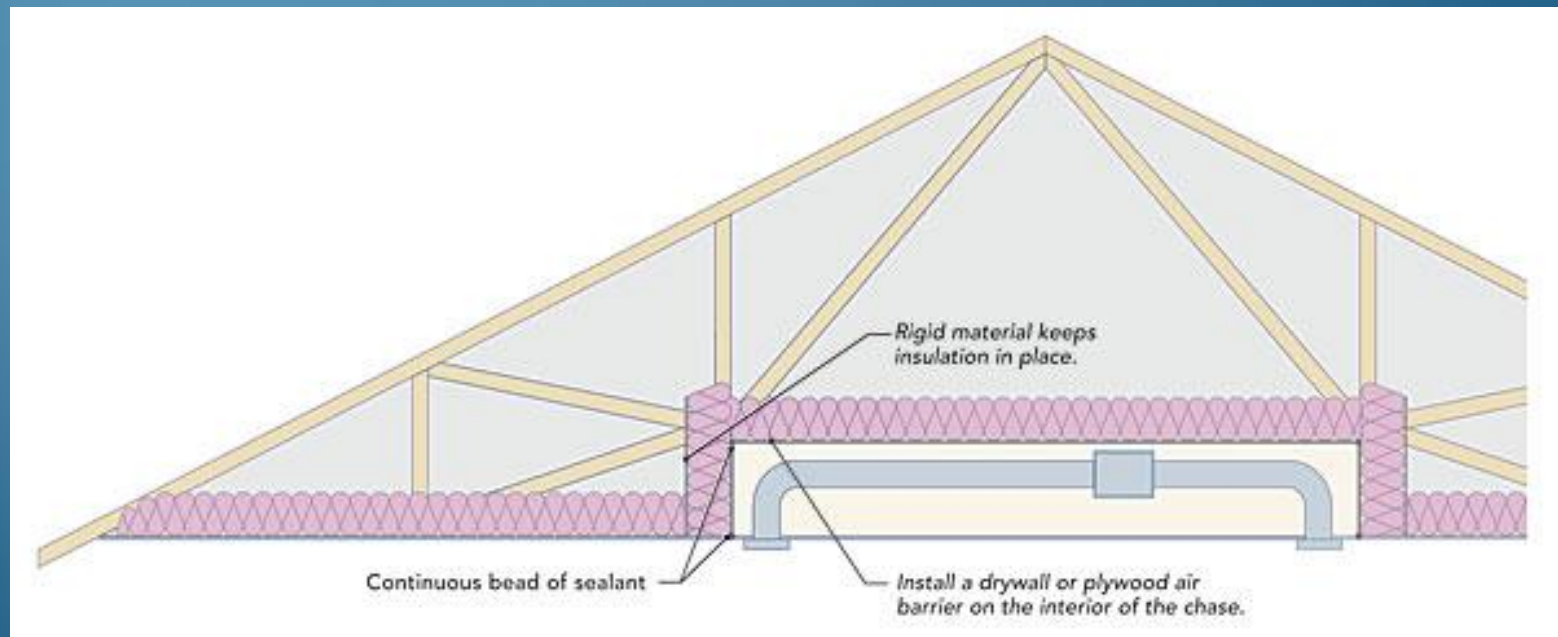
N1103.3.5 Building Cavities

- Building framing cavities are prohibited as air ducts or plenum.



N1103.3.3 Duct Tightness Testing

- Previously deleted from the 2012 code by amendment is now mandatory.
- Ducts inside conditioned spaces shall not be required to be tested.
- New provisions address the methods, minimum coverage requirements and thermal benefits for ducts buried within ceiling insulation, and when those ducts are considered inside the building thermal envelope.



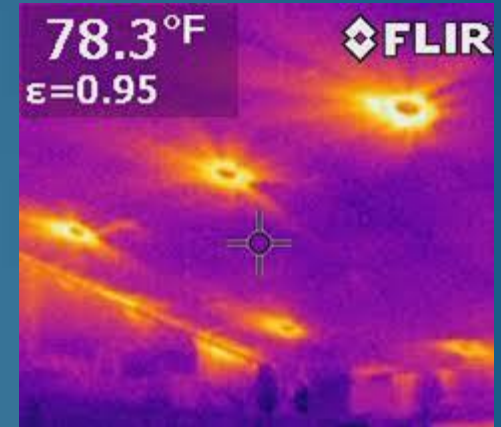
N1102.4.2 Fireplace Doors

- New wood burning fire places shall have tight fitting flue dampers or doors, and outdoor combustion air.
- Where tight fitting doors on factory built fire places are installed, such doors shall be listed and labeled to UL 127.



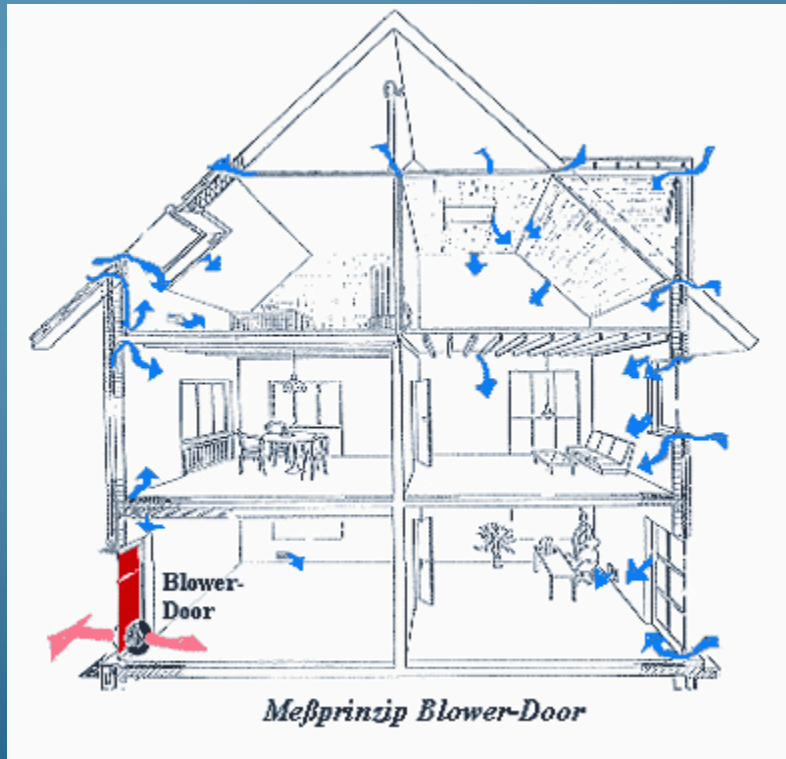
Air Barrier & Insulation

- Supply and Return Register Boots must be sealed to the subfloor or drywall.
- Recessed lighting must be sealed to the finished surface.
- Spaces behind electrical/data boxes need to be insulated.



N1102.4 Building Envelope Testing

- Air Leakage Testing, previously deleted from the 2012 code is now mandatory.
 - Maximum 3 ACH 50 leakage rate.



Manual J—Infiltration Data

Hand-drawn diagram of a house footprint on graph paper. The house is rectangular with a total width of 24 feet and a total depth of 26 feet. The front wall has a central door and two windows. The left wall has one window. The right wall has one window. The back wall has one window. The diagram is labeled with dimensions and window/door symbols. A black marker with "COILING & ELECTRIC" and "19-676-8882" is lying on the graph paper. The word "Crawl" is written in the bottom left corner of the diagram.

WOOD DOORS		HEAT GAIN	
Wood (no storm)	X 6 =		
Wood (w/storm door)	X 6 =		
Insulated metal door	X 6 =		

SQUARE FOOTAGE OF NET WALLS		HEAT GAIN	
Wall perimeter X height	less		
glass and door area = net wall			
No insulation	X 8 =		
R-13 (3.5" insulation)	X 3 =		
R-19 (6" insulation)	X 2 =		

SQUARE FOOTAGE OF CEILING		HEAT GAIN	
No insulation	X 22 =		
R-11 (3" insulation)	X 4.1 =		
R-19 (6" insulation)	X 2.6 =		
R-30 (10" insulation)	X 1.6 =		

SQUARE FOOTAGE OF FLOOR		HEAT GAIN	
No insulation	X 3 =		
Carpet (no insulation)	X 2 =		
R-11 (3"+ insulation)	X 1 =		
Floor on slab	X 0 =		

INFILTRATION / VENTILATION		HEAT GAIN	
Home square feet	X 3.5 =		

INTERNAL GAINS		HEAT GAIN	
Number of people	X 530 =		
Kitchen			
Heat gain	=		

SQUARE FOOTAGE OF CEILING		HEAT GAIN	
No insulation	X 25 =		
R-11 (3" insulation)	X 7 =		
R-19 (6" insulation)	X 4 =		
R-30 (10" insulation)	X 3 =		

SQUARE FOOTAGE OF FLOOR OVER CRAWL AREA		HEAT GAIN	
No insulation	X 19 =		
Carpet (no insulation)	X 9 =		
R-11 (3"+ insulation)	X 4 =		

SQUARE FOOTAGE OF FLOOR OVER BASEMENT		HEAT GAIN	
No insulation	X 19 =		
Carpet or insulation	X 9 =		

PERIMETER OF SLAB FLOOR		HEAT GAIN	
Slab (no insulation)	X 19 =		
Slab (edge insulation)	X 9 =		

INFILTRATION / VENTILATION		HEAT GAIN	
Home square feet	X 3.5 =		

Subtotal BTU/h		HEAT GAIN	
Losses from duct			
In crawl space - (
In attic - (subtot			
Total BTU			
80% furnace			
90% furnace			
Total			

N1104.1 Lighting Efficiency

- 75 % high efficacy lamps increased to 90%.



N1103.6 Mechanical Ventilation Required

- All buildings shall have mechanical ventilation in accordance with M1505.

M1505.4.1 System design.

The whole-house ventilation system shall consist of one or more supply or exhaust fans, or a combination of such, and associated ducts and controls. Local exhaust or supply fans are permitted to serve as such a system. Outdoor air ducts connected to the return side of an air handler shall be considered as providing supply ventilation.

M1505.4.2 System controls.

The whole-house mechanical ventilation system shall be provided with controls that enable manual override.

M1505.4.3 Mechanical ventilation rate.

The whole house mechanical ventilation system shall provide outdoor air at a continuous rate as determined in accordance with Table M1505.4.3(1) or Equation 15-1.

Ventilation rate in cubic feet per minute = $(0.01 \times \text{total square foot area of house}) + [7.5 \times (\text{number of bedrooms} + 1)]$

(Equation 15-1)

Exception: The whole-house mechanical ventilation system is permitted to operate intermittently where the system has controls that enable operation for not less than 25 percent of each 4-hour segment and the ventilation rate prescribed in Table M1505.4.3(1) is multiplied by the factor determined in accordance with Table M1505.4.3(2).

TABLE M1505.4.3(1)
CONTINUOUS WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM AIRFLOW RATE REQUIREMENTS

DWELLING UNIT FLOOR AREA (square feet)	NUMBER OF BEDROOMS				
	0 – 1	2 – 3	4 – 5	6 – 7	> 7
	Airflow in CFM				
< 1,500	30	45	60	75	90
1,501 – 3,000	45	60	75	90	105
3,001 – 4,500	60	75	90	105	120
4,501 – 6,000	75	90	105	120	135
6,001 – 7,500	90	105	120	135	150
> 7,500	105	120	135	150	165

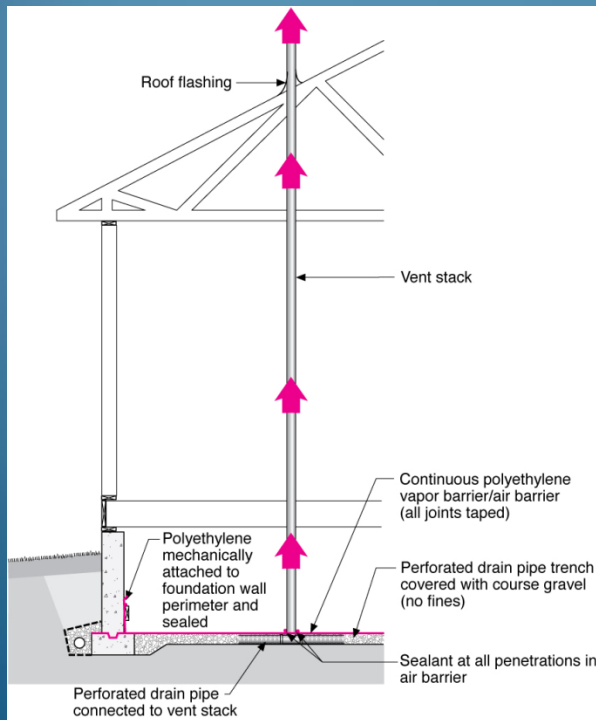
For SI: 1 square foot = 0.0929 m², 1 cubic foot per minute = 0.0004719 m³/s.

Appendix F--Radon

- Amendment to not require the radon vent to extend through the roof is deleted.

Delete the text of *Section AF103.5.3 Vent pipe* in its entirety and substitute the following: A plumbing tee or other approved connection shall be inserted horizontally beneath the sheathing and connected to a 3- or 4-inch-diameter (76 or 102 mm) fitting with a vertical vent pipe installed through the sheathing. The vent pipe shall be extended up through the building floors, and terminate at least 12 inches (305 mm) above the roof in a location at least 10 feet (3048 mm) away from any window or other opening into the conditioned spaces of the building that is less than 2 feet (610 mm) below the exhaust point, and 10 feet (3048 mm) from any window or other opening in adjoining or adjacent buildings.

~~Exception: The vent pipe shall be allowed to terminate in the attic and may be capped unless tests verify the radon potential to be 4 pCi/L or greater.~~

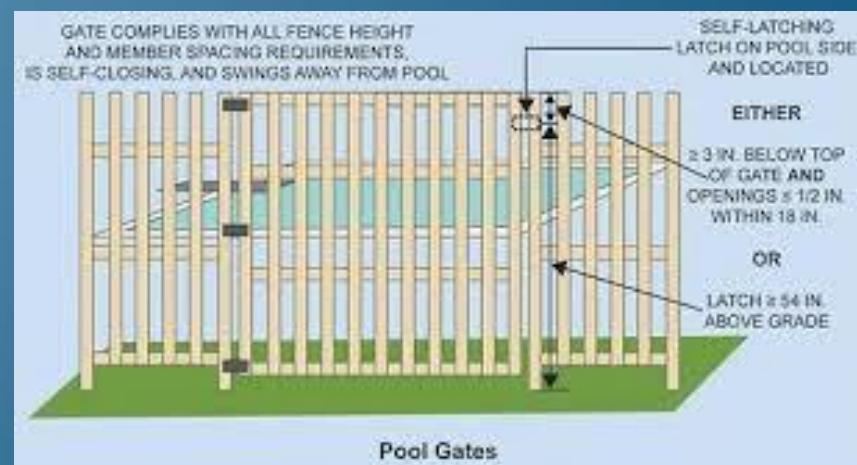




ISPSC

International Swimming Pool and Spa Safety Code

- Pool barrier requirements previously found in Appendix G which were previously excluded by ordinance.
- In addition to any other pool related safety requirements.
- Design criteria for pool structures.





2018 Knoxville Residential Code

Significant Changes

The End. Thank You.

By James Tente, MCP
jtente@knoxvilletn.gov

